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PLANNING STATUS REPORT

WATER RESOURCES APPRAISALS

FOR HYDROELECTRIC LICENSING

WESTERN GREAT LAKES TRIBUTARIES

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PLANNING STATUS REPORT

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING

This is one of a series of revised Planning Status Reports for major river basins in the United States. The original reports, which were prepared several years ago, are being revised as part of a program of Water Resources Appraisals for Hydroelectric Licensing. The revised reports provide updated information on water resources for use by the Federal Energy Regulatory Commission and its staff when considering hydroelectric licensing and other work. The reports present data on water resource developments, existing and potential, and on water use by existing and projected steam-electric generating facilities. The reports also summarize past and current planning studies. The information presented in these reports was abstracted from available sources and involved no new analyses. The report is a staff effort which was not prepared for adoption or approval by the Commission, and does not commit or prejudge later Commission action.

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WESTERN GREAT LAKES TRIBUTARIES

DESCRIPTION OF THE BASIN

The Western Great Lakes Tributaries are located in portions of the States of Michigan, Wisconsin, Illinois, and Indiana. The basin consists of 3 separate drainage areas totaling about 23,000 square miles. These areas are the drainage of the western and southern coast of Lake Michigan extending from the southern edge of Lake Michigan to and including the peninsula at Green Bay; the Upper Peninsula of Michigan with the exception of the area in the Menominee River basin; and the northern portion of the Lower Peninsula of Michigan. Each of the three areas has smaller basins which drain directly into Lake Superior, Lake Michigan, or Lake Huron. Stream profiles and a detailed basin map are included at the end of this report.

The surface drainage system in the basin has few well-developed main and tributary systems. The divides separating the basins are broad and vary from almost level plains to rolling low hills. The topography is not favorable to rapid surface runoff and is conducive to infiltration on medium to coarse textured soils.

Surface and subsurface water resources are interconnected in the basin and, at present, are in ample supply. Groundwater may be obtained almost anywhere. In most areas, water is close to the surface, within reach of deep-rooted trees which exist in abundance.

The streams in the basin obtain a large portion of their flow from groundwater and outflow from the numerous natural lakes in the area. The streams generally have uniform slopes with few abrupt falls and reasonably uniform flow.

Pleistocene glaciation created the geological and topographical features of the basin. Repeated advances of the glaciers scoured pre-glacial valleys, and the receding ice sheets left vast deposits of eroded bedrock and debris. The present land area has a resultant varied topography consisting of depressions occupied by lakes or marshes, level or sloping plains, and rolling hills or ridges. Except where bedrock is exposed, glacial overburden comprising the shores is vulnerable to shoreline erosion.

The Lake Superior area has a continental climate, characterized by wide variations in temperature, normally ample summer rainfall, and a general tendency to extremes in all climatic features. The average January temperature in the Lake Superior basin ranges from 6 to 14 degrees Fahrenheit and the average July temperature ranges between 60 and 64 degrees Fahrenheit. The average annual precipitation varies from 28 to 32 inches.

The Lake Michigan and Lake Huron areas have a continental and semi-marine climate, with variation governed largely by the wind. When the wind is not from the lake direction, the weather is continental; when the wind is from the lake direction, the marine influence predominates. The average annual temperature in the northern portion of the basin near Sault Ste. Marie averages about 30 degrees Fahrenheit, and in the southern portion near Chicago, the temperature averages about 43 degrees Fahrenheit.

Population is quite sparse in the northern rural areas and very dense in the southern industrial areas. Chicago is the largest city in the basin with a 1976 population of about 3.15 million.

The industry of the basin is widely diversified. Not only are many of the basin's resources extensively developed but many of the natural resources of adjacent areas

are processed in the basin. The industries in the vicinity of Chicago and Milwaukee make major contributions to the economy of the southern portion of the basin. The steel mills at Chicago and Gary, the oil refineries in the Calumet area of Indiana, and all the various industries which support them are an important part of the area and national economies.

The principal industrial activities in the northern portion of the basin include mining, lumbering, fishing, quarrying, Great Lakes shipping, and the sportmen's and tourist trade.

The Upper Peninsula area of the basin has fewer and less intensive water quality problems than in the other areas. This is due to the area's sparse resident population and the limited amount of industry. The problem areas that do exist are primarily near the urban areas scattered along the Lake Superior shoreline, tributary streams, and inland lakes. The major causes of the water quality problems are domestic and industrial pollution. Contributing to a much lesser degree are: (1) runoff from agricultural lands, (2) building and land construction, and (3) natural erosive processes.

Concentrations of industry contributing to the water pollution are located in the cities of Munising, Houghton, Hancock, and Marquette, Michigan. Pulp mills, copper and iron mining companies, paper manufacturers, and power companies, in addition to small manufacturing concerns, are located in these and other municipal areas. As a result, coliform concentrations, trace metals, phenols, thermal additions, oxygen-consuming substances, suspended matter, and toxic materials are entering Lake Superior and tributary waters. There are also instances of air pollution as various chemical and fly-ash wastes have been observed in the atmosphere near some of the industrial sites.

The northern portion of the Lower Peninsula of Michigan area of the basin displays areas of potential problems. Although water quality problems have not reached alarming proportions, light algae blooms have occurred in lakes where they were previously unknown, indicating increasing nutrient concentrations. Alpena and several other cities suffer from actions taken decades ago. In the 19th century, Alpena was one of the major lumbering centers of the area. By-products of lumber processing were often deposited in Thunder Bay. Today, governmental officials are continually burdened with the task of removing water-logged debris from various public areas.

The basin's most serious problems are in the Lake Michigan portion and include municipal and industrial wastewater discharges, land-use, and shoreland erosion. Nutrients and total dissolved solids concentrations are increasing primarily due to sewage, industrial waste, and runoff from farm, urban, and natural lands. This is accelerating the eutrophication process of the Lake.

Algae blooms from these nutrients have caused nuisance conditions in the southern portion of Lake Michigan. This problem in combination with erosion, sedimentation, thermal inputs, watercraft discharge, and oil spills contributes to the water quality degradation.

Additional waste treatment facilities are needed in Green Bay to reduce waste discharge. Treated sewage from Chicago is discharged ultimately into the Illinois River,

lessening the waste assimilation burden of the lake. Wastewater from the City of Hammond, Indiana, and the area it serves is also occasionally diverted from the lake. Milwaukee, Wisconsin, discharges all of its treated wastewater into Lake Michigan. The city operates one of the oldest secondary treatment plants on the Great Lakes. During periods of heavy precipitation and combined sewer overflows, raw sewage is discharged into Lake Michigan prior to treatment. The State of Illinois and, as an intervener, the State of Michigan, in an attempt to bring a halt to this practice, filed suit against the City of Milwaukee. Consequently, the U.S. District Court, on July 29, 1977, ordered the City of Milwaukee to negotiate a sewage discharge compliance plan with the States of Illinois and Michigan.

EXISTING WATER RESOURCE DEVELOPMENTS

As shown in table 1, there are 22 major resource development projects existing in the basin, and all are located in the State of Michigan. Sixteen of the projects have hydroelectric plants and six are storage reservoirs only.

The Edison Sault plant located on St. Marys River has an installed capacity of 41,295 kilowatts and is the largest in the basin. Although the hydraulic head at the Edison Sault plant is only 21 feet, the relatively large streamflow enables the plant to generate an average of 297,200 megawatt-hours of electric energy annually. Recently, however, Great Lakes Power Company, Ltd., Sault Ste Marie, Ontario, Canada, has announced plans to redevelop its powerhouse at Sault Ste. Marie on the Canadian side of St. Marys River. Under international treaty with the U.S., the Canadians are allowed to use 50 percent of the river's flow. Presently, the existing plant utilizes a flow significantly less than the allowable maximum. Unused flows are diverted through powerhouses on the American side of the river. After redevelopment, the Canadians are expected to use the maximum allowable flow rates and, as a result, U.S. power production is expected to decrease. The Hillman plant, which is located on the Thunder Bay River, has the smallest hydroelectric installation in the basin. The Alpena Power Company operates this 250-kilowatt plant, which generates about 1,000 megawatt-hours annually.

The topography of the Upper Peninsula of Michigan permitted the development of a number of "high-head" plants. The Carp plant (now retired) on the Carp River developed a gross head of 609 feet by the use of a penstock which is about 5 feet in diameter and over 4 miles long. The high head, combined with a reservoir storage capacity of 22,500 acre-feet, could develop a capacity of 4,480 kilowatts.

In addition to the hydroelectric projects, there are numerous Federally authorized small harbor, navigation, and local flood protection projects in the basin.

There are 20 fossil-fueled steam-electric projects in the basin. The combined installed capacity is 7,567 megawatts. There is also a total of 3,854 megawatts installed at 4 nuclear plants. The 24 steam-electric projects are listed in table 2.

Most of the steam-electric plants employ once-through cooling. The water use values given in table 2 are average values. The actual daily rates are dependent upon power demand and the temperature of the cooling waters. Usually, lesser amounts of water

EXISTING WATER RESOURCE DEVELOPMENTS

Table 1
Existing Hydroelectric Projects
Western Great Lakes Tributaries

Map No.	Project Name	River	Owner Class 1/	Owner	FERC Project No.	Drainage Area (sq mi)	Gross Head (ft)	Installed Capacity (kW)	Average Annual Energy (MWh)	Initial Operation Year	Date of License Expiration
1	Tower Hydro	Black	P	Northern Mich. Elec. Corp.		29[illegible]	22	560	2,100	1917	
2	Kleber	Black	P	Northern Mich. Elec. Corp.		NA	32	1,200	4,000	1949	
3	Ninth Street	Thunder Bay	U	Alpena Power Company	2404(a)	1,27[illegible]	19	1,200	6,000	1910	Dec. 31, 1993
4	Four Mile Dam	Thunder Bay	U	Alpena Power Company	2404(b)	1,26[illegible]	29	1,800	10,000	1913	Dec. 31, 1993
5	Norway Point	Thunder Bay	U	Alpena Power Company	2404(c)	1,26[illegible]	37	4,000	16,000	1924	Dec. 31, 1993
6	Hillman	Thunder Bay	U	Alpena Power Company	2419	NA	16	250	1,000	1953	Dec. 31, 1993
7	Hubbard Lake	So. Branch Thunder Bay	U	Alpena Power Company	2404(d)	NA	storage reservoir			1890	Dec. 31, 1993
8	Upper South Dam	So. Branch Thunder Bay	U	Alpena Power Company	2404(e)	NA	storage reservoir			1931	Dec. 31, 1993
9	Brown Bridge	Boardman	P	Traverse City Light & Pwr. Dept.	2978 4/	NA	29	650	2,300	1921	
10	AuTrain	AuTrain	I	Cleveland-Cliffs Iron Company	2384 2/	8[illegible]	135	896	5,000	1910	
13	Frank J. Russel	Dead	P	City of Marquette	2589 3/	163	34	700	3,900	1924	
14	Development No. 2	Dead	P	City of Marquette	2589 3/	155	132	3,200	12,000	1919	
15	McClure	Dead	I	Cleveland-Cliffs Iron Company	2378 2/	14[illegible]	424	8,000	44,200	1919	
16	Hoist	Dead	I	Cleveland-Cliffs Iron Company	2377 2/	137	142	4,400	14,800	1916	
17	Silver Lake	Dead	U	Cleveland-Cliffs Iron Company	2377 2/	NA	storage reservoir			1912	
18	Prickett	Sturgeon	U	Upper Peninsula Power Company	2402	401	54	2,200	9,400	1931	Dec. 31, 1993
19	Victoria	W. Branch Ontonagon	U	Upper Peninsula Power Company	2382 3/	55[illegible]	218	12,000	64,000	1930	
20	Cisco Lake Dam	So. Branch Ontonagon	U	Upper Peninsula Power Company	2382 3/	NA	storage reservoir			NA	
21	Bergland Dam	W. Branch Ontonagon	U	Upper Peninsula Power Company	2382 3/	NA	storage reservoir			NA	
22	Bond Falls	Middle Br. Ontonagon	U	Upper Peninsula Power Company	1864	19[illegible]	storage reservoir			1939	Dec. 31, 1989
23	Edison Sault	St. Marys	U	Edison Sault Electric Company		80,90[illegible]	21	41,295	297,200	1901	
24	St. Marys Falls	St. Marys	F	Corps of Engineers		80,90[illegible]	21	18,400	161,200	1951	
				Subtotals - Privately Owned Utility			-	62,745	403,600		
				Non-Federal Publicly-Owned Utility			-	6,310	24,300		
				Industrial			-	13,296	64,000		
				Federal			-	18,400	161,200		
						Total		100,751	653,100		

1/ U - Privately-owned utility; P - non-Federal publicly-owned utility; I - industrial; F - Federal.
2/ Cleveland-Cliffs Iron Company filed for withdrawal in response to a 9-24-74 Show Cause Order. The Commission has determined jurisdiction for projects and has not acted on the withdrawal request.
3/ License application pending.
4/ Preliminary permit application.

are required during the winter months. Conversely, summer temperatures often result in larger cooling water needs. Future energy production and water needs for the steam-electric plants located in the basin are given in table 3. Data are not given for plants scheduled for retirement before date shown in the table.

Table 2
Steam Generation - 1975
Western Great Lakes Tributaries

Map No.	State	Name of Plant	Owner	Owner Class 1/	Installed Capacity (MW)	Average Annual Energy (GWh)	Type Prime Mover 2/	Type Cooling 3/	Condenser Flow (MGD)	Withdrawal (MGD)	Return (MGD)	Consumption (MGD)	Source of Cooling Water
32	IN	State Line	Commonwealth Edison Co.	U	968	3,871		OT	760	760	760	4	L. Michigan
33	IL	Waukegan	Commonwealth Edison Co.	U	933	4,109	F	OT	615	615	615	4	L. Michigan
34	IL	Zion	Commonwealth Edison Co.	U	2,196	9,738	NU	OT	1,165	1,165	1,165	11	L. Michigan
35	IL	Winnetka	Village of Winnetka	M	26	14		OT	6	6	6	0	L. Michigan
36	IN	Bailly	Northern Indiana Public Service	U	616	2,686		OT	300	300	300	2	L. Michigan
37	IN	Mitchell	Northern Indiana Public Service	U	529	2,891	F	OT	491	491	491	2	L. Michigan
38	IN	Michigan City	Northern Indiana Public Service	U	736	2,848		OT/WT	333	152	152	5	L. Michigan
39	WI	Commerce B.	Wisconsin Electric Power Co.	U	35	133	F	OT	67	67	67	0	Milwaukee R.
40	WI	East Wells B	Wisconsin Electric Power Co.	U	15	1	F	OT	0	0	0	0	Milwaukee R.
41	WI	Lakeside	Wisconsin Electric Power Co.	U	310	256	F	OT	113	113	113	0	L. Michigan
42 & 44	WI	North Oak Creek South Oak Creek	Wisconsin Electric Power Co.	U	1,692	6,438	F	OT	1,155	1,155	1,155	5	L. Michigan
43	WI	Port Washington	Wisconsin Electric Power Co.	U	400	1,404	F	OT	421	421	421	1	L. Michigan
45	WI	Valley	Wisconsin Electric Power Co.	U	272	921	F	OT	114	114	114	1	Milwaukee R.
46	MI	Shiras	City of Marquette	M	35	159	F	OT	32	32	32	0	L. Superior
47	MI	Presque Isle	Upper Peninsula Generating Co.	U	358	1,856	F	OT	174	174	174	2	L. Superior
48	MI	John H. Warden	Upper Peninsula Power Company	U	19	116	F	OT	35	35	35	0	Keeweenaw Bay
49	WI	Manitowoc	Manitowoc Public Utilities	M	69	213	F	OT	36	36	36	0	L. Michigan
50	WI	Point Beach	Wisconsin Electric Power Co.	U	1,048	6,688	N	OT	807	807	807	7	L. Michigan
51	WI	Edgewater	Wisconsin Power and Light Co.	U	477	2,046	F	OT	142	142	142	2	L. Michigan
52	WI	Kewaunee	Wisconsin Public Service Corp.	U	535	3,341	NU	OT	324	324	324	4	L. Michigan
53	MI	Big Rock Point	Consumer Power Co.	U	75	291	NU	OT	41	41	41	0	L. Michigan
54	MI	Advance	Northern Michigan Electric Coop	C	42	256	F	OT	61	61	61	0	L. Charlevoix
55	MI	Bayside	Traverse Bay Electric Light and Power Co.	M	35	121	F	OT	17	17	17	0	Grand Traverse Bay
			Totals		11,421	50,397							

1/ U - Privately owned utility; M - municipal; C - cooperative.
2/ F - steam: fossil-fueled; NU - steam: nuclear-fueled.
3/ OT - once through; WT - wet tower.

Note: Zero indicates less than 0.5 MGD.

STATUS OF HYDROELECTRIC LICENSING

There are four outstanding licenses issued by the Federal Energy Regulatory Commission (FERC) covering eight developments (table 1). Three of the eight developments are storage reservoirs only. Two license applications, one for three developments owned by the Upper Peninsula Power Company and the other for two developments owned by the City of Marquette, are pending. The Cleveland-Cliffs Iron Company filed for withdrawal of four applications covering six developments located in the basin in response to a September 24, 1974, Show Cause Order. The Commission has determined jurisdiction for the projects and has not acted on the withdrawal request. Application for preliminary permit has been filed for five projects, one existing, and four retired. Four projects in the basin have no licensing status. Of the total installed capacity in the basin, about 9 percent are operating under FERC licenses.

A part of the storage in the Bond Falls Reservoir on the Middle Branch of the Ontonagon River is diverted into the South Branch of the Ontonagon River for use by the Victoria hydroelectric powerplant located about 5 miles downstream from the confluence of the West and South Branches of the Ontonagon River.

There are no pumped storage projects in the area identified as the Western Great Lakes Tributaries.

WATER RESOURCES PLANNING

Prior Studies and Reports

There have been no previous studies which specifically dealt with the area that is being considered in this report. However, there have been studies made which dealt either with an area of which this basin was a part of or with one of the rivers located within the basin. A listing of the major reports follows.

The U.S. Bureau of Outdoor Recreation (now Heritage Conservation and Recreation Service) has published "Water-Oriented Outdoor Recreation in the Lake Superior Basin." Portions of this basin are located in the Western Great Lakes area of consideration. This same agency also published "Water-Oriented Outdoor Recreation in the Lake Huron Basin." Similarly, portions of this basin are located within the Western Great Lakes Tributaries.

The Office of Research and Development, Northern Michigan University, published in 1971 "An Ecological Survey of the Dead River."

The "308" Report of the Corps of Engineers on the Carp River, Michigan, House Document No. 142, 72nd Congress, 1st Session, 1931 investigated navigation, flood control, power development, and irrigation. The report did not recommend participation by the United States in the cost of any water resources development in the Carp River basin.

The "308" Report on the Manistique River, House Document No. 56, 71st Congress, 2nd Session, 1930, concluded that the improvement of the river for navigation, in combination with power development, flood control, or irrigation needs, was not justified at that time.

WATER RESOURCES PLANNING

A Survey Report for Flood Control on the Milwaukee River and Tributaries, dated November 1964, was prepared by the Chicago District of the Corps of Engineers. The improvement plan recommends a channel to divert flood flows from the Milwaukee River, above Milwaukee to Lake Michigan. It is estimated that flood damage along the Milwaukee River, from its mouth to Saukville about 30 miles upstream, would be reduced by 92 percent.

In addition to these reports, there have been numerous pollution, navigation, harbor, and local flood protection project studies made in connection with the Great Lakes area.

Current Studies

Under the Water Resources Act of 1976, the Secretary of the Army, acting through the Chief of Engineers, is carrying out a demonstration program for assessing the adverse and beneficial impacts which may result from possibly increasing Lake Michigan diversions at Chicago from 3,200 to 10,000 cubic feet per second. The Program is scheduled for completion in 1981.

A Great Lakes and St. Lawrence Seaway Navigation Season Extension Study was undertaken to determine the feasibility of extending navigation year-round. A demonstration program has been initiated.

In connection with the great amount of navigation on the Great Lakes, the Corps of Engineers is presently engaged in a number of channel and harbor improvement studies. These studies consider the advisability of improvements for small craft, general navigation improvements such as enlargement of turning basins and deepening of channels, and the need for control of the Great Lakes water levels. The Corps of Engineers also has studies underway for local flood protection projects.

Ongoing Studies

The Second National Water Assessment is the second Nationwide Evaluation of the Water Resources Council as required by P.L. 89-80 to maintain a continuing study of the adequacy of the Nation's water and related land resources to meet present and future requirements for these resources. The first such assessment was reported on by the Council in 1968. The second assessment, reported on in 1978, found that significant achievements have been made in the past decade since the first assessment in preserving water and harnessing its power with a growing interest in water conservation and environmental protection. However, greater efforts are needed to insure the protection of our water resources and to solve the complex water and related land problems which still exist.

A Great Lakes Basin Framework Study was begun in 1967 under the aegis of the Great Lakes Basin Commission to develop an information base and to prepare components for a future Comprehensive Coordinated Joint Plan (CCJP) for the conservation, use, and development of water and land resources in the Great Lakes area through the year 2020. The Commission membership is comprised of representatives of State and Federal agencies involved with planning of water resources development within the basin. The Framework Study with its associated Level A, B, and C studies is the basis for the CCJP which is to be prepared for the U.S. Water Resources Council as required by P.L. 89-80.

WATER RESOURCES PLANNING

The Framework Study, which is the first and broadest level (Level A), evaluated and appraised on a broad basis the needs and desires of the people for the conservation, development, and utilization of water and related land resources and identified regions (hydrologic, political, economic, etc.) with complex problems which require more detailed investigations and analyses. This study, published in 1976, did not involve basic data collection, cost estimating, or detailed plan formulation. The Level B studies, which are now being done, consist of preliminary and reconnaissance water and related land plans for selected areas or river basins. The final level, Level C, will be done in the future and will consist primarily of specific project or program feasibility studies in the river basins or regions.

The Comprehensive Coordinated Joint Plan (CCJP) prepared by the Great Lakes Basin Commission is related to the Framework Study in that it is the current recommended regional plan resulting from the same continuous planning process involving Federal, State, interstate, and local agencies concerned with the conservation, development, and utilization of water and related land resources. The CCJP (Regional Plan) was required by the Water Resources Planning Act (P.L. 89-80) and is a basic component of the National Planning Strategy being developed by the U.S. Water Resources Council. The other two basic components of this strategy are Nationwide Evaluation and Statewide Plans.

POTENTIAL WATER RESOURCE DEVELOPMENTS

Table 4 lists 7 undeveloped hydroelectric sites in the basin with potential installations greater than 4,000 kilowatts. Since the installations are small, it is doubtful if any of the sites would be economically feasible for development. Development of the 7 potential sites would provide a combined capacity of about 65,400 kilowatts which is equivalent to about 40 percent of the basin's existing hydroelectric capacity. The average annual output of the sites would be about 168,100 megawatt-hours.

Future studies may identify potential hydroelectric power at small existing dams. The hydroelectric projects shown in table 5 have been retired from service since 1959; however, due to changing economic conditions regarding energy sources and their development, these plants and others retired earlier should be studied for potential redevelopment.

Presently, there are no rivers included or under study for inclusion in the National Wild and Scenic Rivers System. Therefore, the development of hydropower would not be precluded because of this program.

Under its Natural River Act of 1970, Act No. 231, the State of Michigan designated the Two Hearted, Boardman, and Jordan Rivers as natural rivers. The State has under study for inclusion the Indian, Fox, Black, and Pigeon Rivers. Also, the State has proposed for study the Ontonagon, Sturgeon, Huron, Tahquamenon, and Thunder Bay Rivers. Under the system, there are three classifications of natural rivers: (1) Wilderness River - a free flowing river with essentially primitive, undeveloped adjacent land; (2) Wild-Scenic - a river with wild, forested borders; near development, and moderately accessible; and (3) Country-Scenic - a river in an agricultural setting with pastoral borders, some homes and readily accessible.

Table 3

Estimated Cooling Water Requirements 4/ Steam-Electric Powerplants

Map No.	Name of Plant	Type Prime Mover 2/	Type Cooling 3/	Capacity (MW)	Annual Generation (GWh) 1/	Condenser Flow (MGD)	Water Withdrawal (MGD)	Return (MGD)	Consumption (MGD)
32	State Line								
	1985	F	OT	614	1,858	365	365	365	2
	2000								
33	Waukegan								
	1985	F	OT	933	2,418	362	362	362	2
	2000								
34	Zion								
	1985	NU	OT	2,196	13,386	1,602	1,602	1,602	16
	2000	NU	OT	2,196	10,540	1,261	1,261	1,261	12
36	Bailly								
	1985	F	OT	616	2,227	249	249	249	2
	2000	F	OT	422	1,062	119	119	119	1
	1985	NU	WT	660	4,625	403	14	5	9
	2000	NU	WT	660	3,769	329	11	4	7
37	Mitchell								
	1985	F	OT	529	2,302	391	391	391	2
	2000	F	OT	115	353	60	60	60	0
38	Michigan City								
	1985	F	OT/WT	585	2,268	228	39	35	4
	2000	F	WT	515	1,442	135	5	2	3
42 & 44	North & South Oak Creek								
	1985	F	OT	1,692	4,370	784	784	784	3
	2000	F	OT	323	390	70	70	70	0
45	Valley								
	1985	F	OT	272	775	96	96	96	1
	2000	F	OT	272	362	45	45	45	0
46	Shiras								
	1985	F	OT	35	85	17	17	17	0
	2000	F	OT	35	41	8	8	8	0
47	Presque Isle								
	1985	F	OT	335	1,420	133	133	133	1
	2000	F	OT	218	435	41	41	41	0
49	Manitowoc								
	1985	F	OT/WT	107	371	36	18	18	0
	2000	F	WT	57	126	8	0	0	0
50	Point Beach								
	1985	NU	OT	1,048	7,344	887	887	887	8
	2000	NU	OT	524	2,762	333	333	333	3
51	Edgewater								
	1985	F	OT	420	1,651	114	114	114	1
	2000	F	OT	351	686	48	48	8	1
52	Kewaunee								
	1985	NU	OT	535	3,785	367	367	367	4
	2000	NU	OT	535	2,846	276	276	276	3
53	Big Rock Point								
	1985	NU	OT	75	525	74	74	74	1
	2000								
54	Advance								
	1985	F	OT	42	207	50	50	50	0
	2000	F	OT	27	78	19	19	19	0
55	Bayside								
	1985	F	OT	28	75	11	11	11	0
	2000								

1/ (GWh) - gigawatt hours (1×10^6 kilowatt-hours).
2/ F- steam, fossil-fueled; NU - steam, nuclear-fueled.
3/ OT - once through; WT - wet tower.
4/ Plants having a capacity of 25 MW or greater.

Note: Zero indicates less than 0.5 MGD.

POTENTIAL WATER RESOURCE DEVELOPMENTS

Table 4

Potential Hydroelectric Projects
Western Great Lakes Tributaries

Map No.	Project Name	River	Drainage Area (sq mi)	Gross Head (ft)	Installed Capacity (kW)	Average Annual Energy (MWh)
25	Tahquamenon	Tahquamenon	840	93	4,500	30,000
26	Lower Plant	Sturgeon	322	90	16,300	19,100
27	Big Falls	Sturgeon	322	110	17,600	23,800
28	Tibbetts Falls	Sturgeon	155	112	12,000	12,200
29	Grand Rapids	Ontonagon	1,310	55	4,800	32,000
30	Forks	Ontonagon	1,290	40	4,200	28,000
31	Hooper	West Branch Ontonagon	610	70	6,000	23,000
				Total	65,400	168,100

Under its Wilderness and Natural Areas Act of 1972, the State of Michigan has dedicated 42,949 acres and is processing 24,930 acres for dedication and rededication as shown in table 6.

There are no Federal or State designated wild and scenic rivers in the Illinois, Indiana, or Wisconsin portion of the Western Great Lakes Tributaries.

Existing national parks, forests, etc., that are located in the Western Great Lakes Tributaries, are shown in table 7. These areas could affect the development of hydroelectric power within their boundaries.

Table 5

Retired Hydroelectric Projects
Western Great Lakes Tributaries

Map No.	Project Name	River	Owner	Gross Head (ft)	Installed Capacity (kW)	Average Annual Energy (MWh)	Initial Operation Year	Year Retired
56	Alverno	Black	Consumers Power Co.	19	800	2,800	1950	1965
57	Cheboygan	Cheboygan	Consumers Power Co.	14	1,800	6,400	1950	1965
58	Manistique	Manistique	Manistique Pulp & Paper Company	26	3,238	1,300	NA	1964
59	Development No. 1	Dead	City of Marquette	90	1,000	700	1912	1974
60	L'Anse	Falls	Village of L'Anse	NA	100	500	1908	1971
61	Elk Rapids	Elk	Consumers Power Co.	11	1,050	2,200	1950	1965
62	Bellaire	Intermediate	City of Charlevoix 1/	15	375	1,400	1918	1973
63	Sabin	Boardman	City of Traverse 1/	19	1,000	2,900	1950	1969
64	Boardman No. 3	Boardman	City of Traverse 1/	41	2,200	6,000	1950	1969
65	Keystone	Boardman	City of Traverse	22	500	2,300	1909	1961
66	Boyne River	Boyne	Consumers Power Co.	32	500	1,300	1950	1963
67	Homestead	Betsie	Consumers Power Co.	27	600	3,000	1934	1963
68	Carp	Carp	Cleveland-Cliffs Iron Company	609	4,480	19,100	1912	--
69	Deer Lake	Carp	Cleveland-Cliffs Iron Company	Storage Reservoir			1912	--
70	Leland	Lake Leelanau	Michigan Public Service Company	10	245	--	--	--
71	Rugg	Cedar	Michigan Public Service Company	21	160	500	--	--
72	Stover	Cedar	Michigan Public Service Company	26	136	--	--	--
73	Maple River	Maple	Michigan Public Service Company	17	224	--	--	1951
74	Lower	Bear	City of Petoskey	21	120	500	--	--
75	Mitchell	Bear	City of Petoskey	28	500	1,000	--	--
76	Upper	Bear	City of Petoskey	21	250	700	--	--
77	East Jordan	Deer Pine	Michigan Public Service Company	26	149	--	--	--
78	Union Street	Boardman 1/	City of Traverse	9	220	1,509	--	--

1/ *Application for permit to study reactivation.*

Note: NA - not available.

Table 6

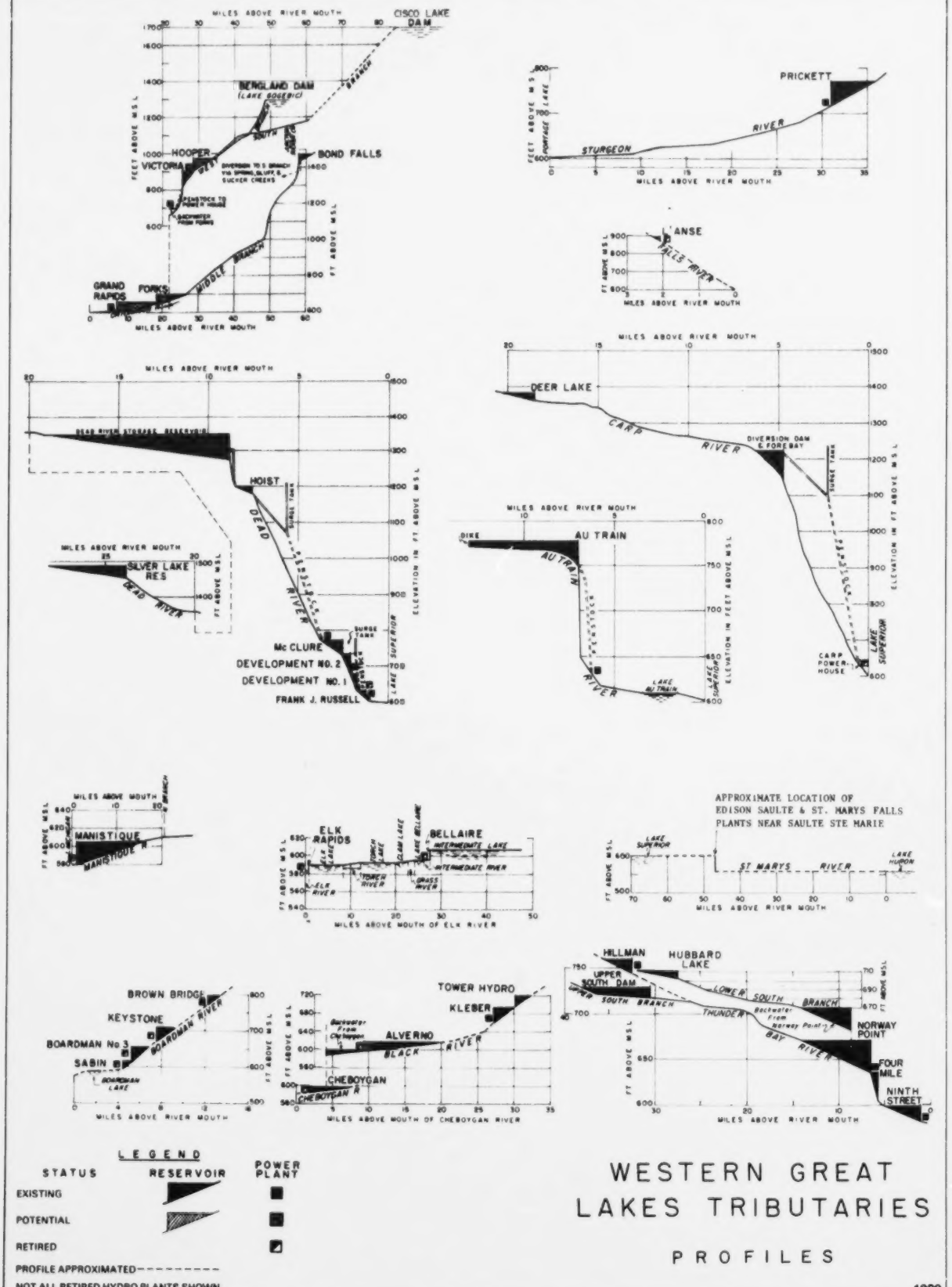
State Wilderness and Natural Areas
Western Great Lakes Tributaries

County	State Area & Tract	Area (acres)	Status
Dedicated			
Ontonagon & Gogebic	Porcupine Mts. Wilderness S.P.		
	- wilderness area	40,808	Rededicated as wilderness area 1976
	- Presque Isle, River area	1,465	Rededicated as scenic site 1976
	- Union Springs	160	Dedicated as scenic site 1976
Alger	Wager Falls	22	Rededicated as scenic site 1976
Alger	Laughing Whitefish Falls	360	Rededicated as scenic site 1976
Presque Isle	Besser Natural Area	134	Rededicated as natural area 1974
	Total	42,949	
Being Processed			
Mackinac (Bois Blanc administered from Region II)	Bois Blanc Island		(Previously dedicated 1955)
	- Northshore	721	Rededication as research natural area
	- Beach Ridge	480	Dedication as research natural area
	- Central Woodland	1,106	Dedication as research natural area
	- Mixed Forest	984	Dedication as nature study area
	- Snake Island-Mud Lake	244	Dedication as nature study area
Chippewa & Luce	Tahquamenon Falls State Park	2,692	(Previously dedicated 1960) Rededication as two scenic sites, nature study area & research natural area
Chippewa & Luce	Tahquamenon Falls S.P. & Betsy Lake Area (1 area)	16,313	(Betsy Lake previously dedicated 1954) Rededication as wilderness area
Emmet	Wilderness State Park (4 areas)	2,390	(Previously dedicated 1951) Rededication as two nature study areas & two research natural areas
	Total	24,930	

Table 7

Federal Natural Areas
Western Great Lakes Tributaries

	Area (acres)	County	Notes
United States Forest Service			
Northern Hardwoods			
Hiawatha National Forest	200	Alger	
Virgin Cedar			
Ottawa National Forest	283	Gogebic	
McCormick Experimental Forest	17,000	Marquette	
I --	3,675		hardwoods, pinelands
Imp Lakes Natural Area		Gogebic	virgin stand & bogs
National Park Service			
Isle Royale National Park	130,000	Keweenaw	
I Passage Island	104		
Pictured Rocks National Lakeshore		Alger	40 miles of sandstone cliffs and pebble beaches
U.S. Bureau of Sport Fisheries & Wildlife			
Seney Wildlife Refuge		Schoolcraft	
I Strangmoor	640		
II Hemlock	500		
III Northern Hardwood	500		
IV Red Pine	640		
V --	25,150		
Huron National Wildlife Refuge			
(Huron Islands)	47	Baraga	rocky habitat
U.S. Bureau of Sport Fisheries & Wildlife			
Pismire Island & Shoe Island	12	Charlevoix	"Michigan Islands"
Scarecrow Island		Alpena	



WESTERN GREAT LAKES TRIBUTARIES

PROFILES

1980

FERC—Water Resources Appraisals For Hydroelectric Licensing

Figure 1

FERC—Water Resources Appraisals For Hydroelectric Licensing

Figure 2

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